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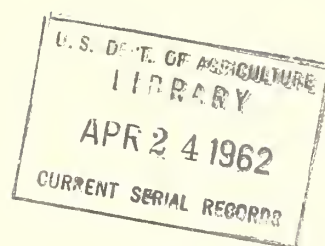
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GRADES OF
HOGS
SLAUGHTERED IN THE UNITED STATES, SEPTEMBER 1960 THROUGH AUGUST 1961

CONTENTS

Washington, D. C.   April 1962

SUMMARY AND CONCLUSIONS

The grade composition of barrows and gilts slaughtered in the United States from September 1960 to August 1961 is estimated to be:

> 33 percent U. S. No. 1,
> 39 percent U. S. No. 2,
> 26 percent U. S. No. 3,
> 2 percent Medium, and
> less than one-half of 1 percent Cull.

To obtain this estimate, a Department of Agriculture hog grading specialist spent the year traveling to 56 packing plants. At each plant he spent 1 or 2 days grading hog carcasses as they hung on the killing line, just before they went into the cooler. He made two visits, at 6-month intervals, to each of the 56 plants. About 45,000 barrow and gilt carcasses were graded over the year.

The national percentage estimates for barrows and gilts given above are considered accurate within about 1.5 percentage points. For accurate regional or seasonal grade estimates, at least two graders would be needed so that more plants could be visited and more hogs graded.

The sample was drawn to represent all hogs. Since it was composed mainly of barrows and gilts, reliability of data on sow carcasses is not known. About 6,000 sow carcasses were graded during the year's work. The distribution of these sow carcasses by grades was:

> 34 percent U. S. No. 1 sow,
> 35 percent U. S. No. 2 sow,
> 24 percent U. S. No. 3 sow,
> 7 percent Medium sow, and
> 1 percent Cull sow.

If more such studies are conducted and normal year-to-year variations in grade consist are determined, a base will have been established for measuring future changes in hogs.

GRADES OF HOGS SLAUGHTERED IN THE UNITED STATES
SEPTEMBER 1960 THROUGH AUGUST 1961

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INTRODUCTION

During World War II, farmers' cash receipts for hogs accounted for nearly half of their receipts for all meat animals. By 1959, this proportion had been reduced to just over one-fourth. Hogs are still an important source of income to farmers, but their importance may continue to decline unless farmers produce more meat-type and fewer lard-type hogs than they are now doing.

It seems generally agreed that there has been some improvement in the quality of slaughter swine over the past several years. To some extent, this impression could have been due to the fact that slaughter weights were generally lower tin the 1950's than in the 1940's, with the result that hogs did not get so fat. Improvement is also suggested by records of livestock shows and swine testing stations which have shown a definite tendency for the weight of lean cuts as a percentage of carcass weight to rise over recent years. But show and station hogs do not necessarily represent all hogs marketed. The extent to which any improvement in hog quality is due to more careful sorting for marketing at proper weights and to improvement of inherent quality is not known.

Information on the proportion of market hogs in the different grades has been fragmentary and conjectural, and no estimates of known reliability have previously been made for any wide area. Accurate estimates of the proportion of butcher hogs coming to market in each of the grades will help provide a benchmark from which progress in improving hog quality can be measured.

PROCEDURE

In this study, a randomly selected sample of packing plants was visited by a hog grading specialist. The grader spent at least 2 full days at each plant, 1 or 2 days in the fall or winter of 1960-61 and 1 or 2 days 6 months later. He graded a sample of each plant's hog carcasses as they moved by him on the killing line, just before they went into the cooler. The grader measured and graded every second, third, fourth, fifth, or sixth carcass passing him, depending upon rail speed. During this one-year survey, about 45,000 barrow or gilt carcasses and about 6,000 sow carcasses were measured and graded.

Plants Visited

Figure 1 shows the locations of the sampled packing plants and also the regional boundaries within which sample draws were made from lists of qualified plants.
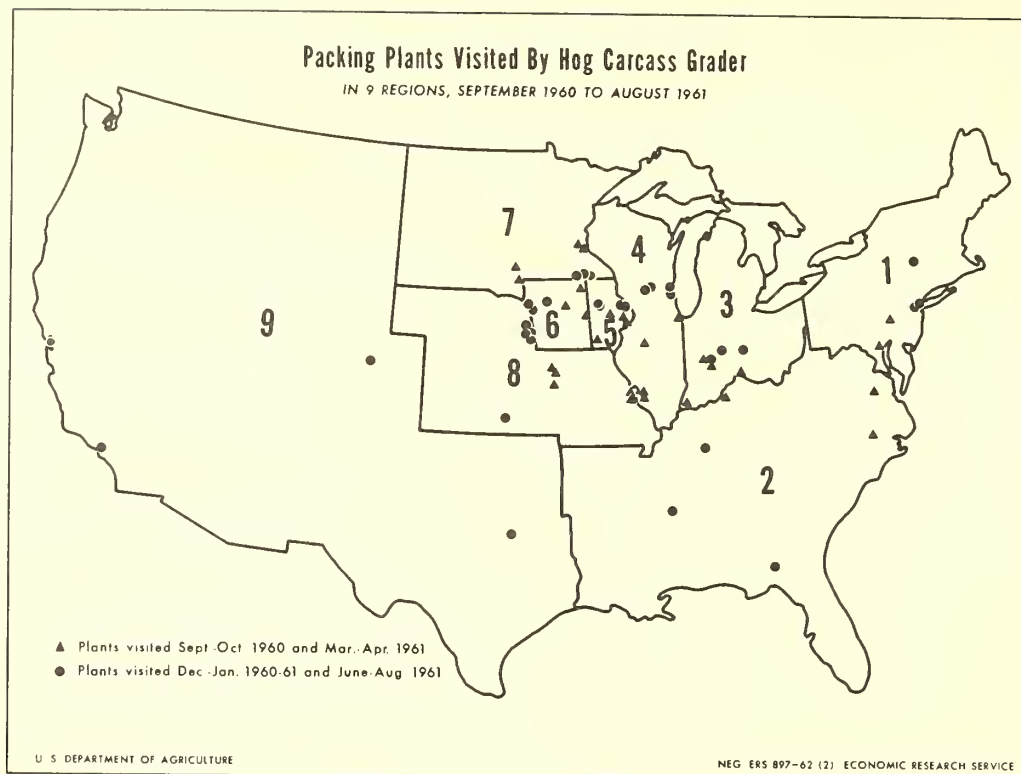
Figure I

The sample was drawn from the 145 federally inspected plants which qualified for this purpose by slaughtering 100,000 or more hogs in 1959. These plants accounted for 82 percent of total commercial slaughter and about 96 percent of federally inspected slaughter. Sixty-one pairs of visits (6 months apart) were made to 56 of these 145 plants. Five plants fell into the sample twice; the grader spent 2 days at each visit to these plants. Plants drawn twice are dotted twice on the map (fig.1). One plant ceased hog operations during the study and received only one visit. One large plant was closed at the time of a scheduled 2-day visit. Two nearby plants were substituted. The selection of the plants to be visited is described in more detail in the appendix.

The grader made four trips during the year's work. In the first and third trips, he visited the plant locations shown by triangles in figure 1. In the second and fourth trips, he visited the plants indicated by circles. With two exceptions, each sampled plant was visited twice, with a 6-month interval between visits.

Criteria for Evaluating Carcasses

The grader assigned a grade to each carcass included in the sample. He also measured carcass length (from the forward point of the aitch bone to the forward edge of the first rib) and computed average backfat thickness from measurements made opposite the first and last ribs and the last lumbar vertebra. The data form he used is shown in figure 2.

Page

PLANT CODE

DATE

HOG CARCASS GRADE SURVEY

START AND STOP TIMES	CARCASS LENGTH	AVERAGE BACKFAT THICKNESS	GRADE	COMMENTS
1				
2				
3				
4				
5				
6				
29				
30				
31				
32				
33				
34				
35				

Figure 2

Barrows and Gilts

For barrows and gilts average backfat thickness, related to carcass weight or length, is a major factor in grading. An accurate appraisal of yield and quality of cuts requires consideration of such additional factors as thickness of muscling and distribution of finish.

The typical U. S. No. 1 carcass is expected to have a high yield of valuable lean cuts and the minimum fatness required to produce high-quality cuts. U. S. No. 2 carcasses are somewhat fatter, and U. S. No. 3 carcasses are decidedly overfat. Medium and Cull carcasses are too thin to yield top quality pork cuts. The weight and measurement guides in the official standards for grades of barrow and gilt carcasses are given in table 1. The history of the research and development of the standards has been given in another report (1). 1/ U. S. grades for live hogs have been explained and illustrated in several Department of Agriculture publications (6, 7).

Sows

Grade specifications for barrows and gilts permit more backfat thickness either heavier or longer carcasses (table 1). For sow carcasses, however, length and weight appear to have little additional influence on the proportion of valuable cuts after the influence of backfat has been considered. For this reason length and weight are not included in grade specifications for sow carcasses.

1/ Underscored figures in parenthesis refer to items in Literature Cited p.

Table 1.--Weight and measurement guides in official standards for grades of barrow and gilt carcasses 1/

Carcass weight or length 2/	Average backfat thickness by grade 3/				
	U. S. No. 1	U. S. No. 2	U. S. No. 3	Medium	Cull
	Inches	Inches	Inches	Inches	Inches
Under 120 pounds or under 27 inches..............	1.2 to 1.5	1.5 to 1.8	1.8 or more	0.9 to 1.2	Less than 0.9
120 to 164 pounds or 27 to 29.9 inches..............	1.3 to 1.6	1.6 to 1.9	1.9 or more	1.0 to 1.3	Less than 1.0
165 to 209 pounds or 30 to 32.9 inches..............	1.4 to 1.7	1.7 to 2.0	2.0 or more	1.1 to 1.4	Less than 1.1
210 or more pounds or 33 or more inches..............	1.5 to 1.8	1.8 to 2.1	2.1 or more	1.2 to 1.5	Less than 1.2

1/ Source: U. S. Department of Agriculture. Official United States Standards for Grades of Pork Carcasses (Barrow and Gilt: Sow). AMS Serv. and Regulat. Announc. 171. 1958.
2/ Weight is based on a chilled, packer-style carcass. Length is measured from the forward point of the aitch bone to the forward edge of the first rib. Most carcasses of a given weight have the length shown for that weight is this table. For carcasses where weight (in relation to backfat thickness) indicates one grade and length indicates another, the grade is determined subjectively as provided in the standards.
3/ Average of measurements made opposite the first and last ribs and last lumbar vertebra.

The following backfat thickness guide has been published by the Department of Agriculture to provide an objective basis for determining the grade of sow carcasses (5):

Grade	Average backfat thickness
U. S. No. 1	1.5 to 1.9 inches
U. S. No. 2	1.9 to 2.3 inches
U. S. No. 3	2.3 or more inches
Medium	1.1 to 1.5 inches
Cull	Less than 1.1 inches

As in grading barrows and gilts, other factors besides backfat thickness are considered in grading sow carcasses.

GRADES OF BARROWS AND GILTS

U. S. Average

About 45,000 barrow and gilt carcasses were graded over the course of the year. The estimated U. S. average grade distribution for September 1960 to August 1961 was:

	Percent
U. S. No. 1	33.4
U. S. No. 2	38.6
U. S. No. 3	25.9
Medium	2.0
Cull	0.1
	100.0

There was some variation from plant to plant in the number of carcasses graded. However, since each plant in the sample represented approximately the same proportion of federally inspected slaughter in 1959, the first step in building up the national estimate was simply to average the proportions in each grade at each plant. This was done separately for each trip. The second step was to weight the results by the relative volume of federally inspected slaughter during the 2 months of each trip. 2/

Regional Differences

Results obtained from four parts of the country were compared to see whether differences existed between regions. The areas compared (fig. 1) were region

2/ See section on "Carcasses in Survey" for percentages in each grade before weighting. The numbers of barrows and gilts, in thousand head, slaughtered under Federal inspection during the months of the four trips were:

First trip (September and October 1960)	9,639
Second trip (December 1960 and January 1961)	10,612
Third trip (March and April, 1961)	10,475
Fourth trip (June and July, 1961)	8,026

The 95 percent confidence limits above and below the estimate for each grade are: 1.6 percent for U. S. No. 1, 1.0 percent for U. S. No. 2, 1.7 percent for U. S. No. 3, 0.4 percent for Medium, and 0.1 percent for Cull.

1 and 2 combined, regions 3 and 4 combined, regions 5 and 6 combined, and regions 7, 8, and 9 combined.

There were no marked differences between the U. S. average barrow and gilt grade distribution and that for any of the four areas. Differences did appear among the nine small regions, but, because of the small number of carcasses graded in each of the nine regions, the differences were not statistically significant.

Differences Between Trips

Although the grade consist in the major regions studied did not differ significantly from the U. S. average, there were important differences which seemed to depend on the time of the year. The results of trip 1 (September-October 1960) and trip 3 (March-April 1961) can be compared on a matched-plant basis because the same plants were visited both trips. The same can be said for trips 2 and 4 (December 1960-January 1961, and June, July, and part of August 1961).

The proportion of U. S. No. 1 carcasses was higher in September and October 1960 than in March and April 1961; and higher in December and January 1960-61 than in June and July 1961. 3/ Table 2 shows the average percentage of each grade for each trip and the differences between the two pairs of trips.

The objective backfat measurements substantiated the grade differences found between pairs of trips. In trip 1, 44.0 percent of all barrows and gilts had backfat thickness of 1.6 inches or less, versus 33.0 percent for trip 3. In trip 2, 39.0 percent had backfat of 1.6 inches or less versus 35.8 percent for trip 4.

Carcasses in Survey

Tables 3 to 6 contain the backfat and length distribution of the 45,000 barrow and gilt carcasses. The data were adjusted so that equal weight is given to each plant, but not adjusted for the differing volumes of federally inspected slaughter during the months of each trip. The data for each grade were weighted according to the relative importance of that grade at each plant. Therefore, the totals in tables 3 to 6 can be added together to obtain the overall backfat-length distribution of all barrows and gilts graded, and the individual totals indicate the average importance of each grade.

These tables also illustrate how the grader evaluated borderline carcasses. All entries in any individual table represent the carcasses placed in that grade by the grader. The boundaries of the official weight and measurement guides are

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3/ A North Dakota study found a similar drop in quality from September 1955 to July 1956 at the West Fargo market, but the next year's August-September peak was not as high as in the preceding year (2). There appears to be some variation in quality from season to season, but the variation may not be consistent from one year to the next.
The cost of feed relative to present and expected hog prices can be expected to influence market weights during the year as well as between years and may affect grade due to a relationship between weight and grade. The hog-corn price ratio does not follow an identical pattern from one year to the next.
Examination of recent monthly data from Canada indicates no marked seasonal pattern there.

Table 2.--Distribution of barrow and gilt carcass grades found at 2 groups of packing plants visited by grader, and differences between findings in 2 visits to each group 1/

Grade	First group of plants visited			Second group of plants visited		
	Trip 1, Sept.-Oct 1960	Trip 3, Mar.-Apr. 1961	Difference	Trip 2, Dec.-Jan. 1960-61	Trip 4, June-Aug. 1961	Difference
	Percent	Percent	Percentage points	Percent	Percent	Percentage points
U. S. No. 1.......	40.3	29.3	2/ 11.0	34.5	28.4	2/ 6.1
U. S. No. 2......	36.7	37.3	-.6	40.0	40.9	-.9
U. S. No. 3......	20.5	31.5	2/-11.0	23.6	28.2	2/-4.6
Medium..........	2.4	1.8	.6	1.9	2.2	-.3
Cull.............	.1	.1	0	.1	.2	-.1
Total.........	100	100	--	100	100	--

1/ The detailed figures do not add to exactly 100 percent because of rounding.
2/ Highly significant in a statistical or probability sense.

superimposed on each table. Carcasses outside these boundaries were placed in the grade because of apparent deficiencies or superiorities in development of muscling, etc.

If the grading had been done solely on the basis of the measurement guides (table 1) and no subjective evaluations used, the following barrow and gilt grade distribution would have resulted:

	Percent
U. S. No. 1..............	30.39
U. S. No. 2..............	38.30
U. S. No. 3..............	24.54
Medium..................	6.14
Cull....................	.63
	100.00

For this tabulation, half the carcasses on the grade boundaries were placed in each adjacent grade.

In actual practice the grader made certain judgments on borderline carcasses. He found, for example, that about two-thirds of the carcasses within the Medium measurements had enough apparent quality to be graded U. S. No. 1. Practically no carcasses were graded Medium while clearly within the U. S. No. 1 measurements.

Table 3.--U. S. No. 1 barrows and gilts: Distribution of carcasses by length and average backfat thickness, as percentages of all barrows and gilts graded in survey, 56 packing plants, September 1960 to August 1961 [1]

Carcass length	Average backfat thickness (inches)								
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	Total
Inches	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
25 to 25.9.....................		0.02	0.01	0.01	[2]				0.04
26 to 26.9.....................	0.01	.03	.09	.07	0.01				.21
27 to 27.9.....................	.01	.12	.35	.50	.36	0.02			1.36
28 to 28.9.....................	.03	.26	.63	1.33	2.16	.42			4.83
29 to 29.9.....................	.02	.24	.83	2.02	3.78	2.56	0.05		9.50
30 to 30.9.....................	.01	.20	.72	1.50	3.18	3.18	.18		8.97
31 to 31.9.....................	.01	.07	.40	.77	1.71	2.05	.27		5.28
32 to 32.9.....................		.02	.10	.32	.69	.78	.32		2.23
33 to 33.9.....................			.03	.05	.15	.19	.08	0.02	.52
34 to 34.9.....................				.01	.02	.02	.03		.08
35 to 35.9.....................						.01	.01		.02
Total	.09	.96	3.16	6.58	12.06	9.23	.94	.02	33.04

1/ The grader recorded backfat and length to the nearest tenth inch. Data are not adjusted for differing volumes of federally inspected slaughter during the months of each trip.

2/ Area between dotted lines is the range of backfat thickness for each carcass length according to the weight and measurement guides in the official standards for U. S. No.1.

Table 4.--U. S. No. 2 barrows and gilts: Distribution of carcasses by length and average backfat thickness, as percentages of all barrows and gilts graded in survey, 56 packing plants, September 1960 to August 1961

Carcass length	Average backfat thickness (inches)								
	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	Total
Inches	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
24 to 24.9.....................	0.01	0.01			[1]				0.02
25 to 25.9.....................		.05	0.03	0.01					.09
26 to 26.9.....................	.02	.16	.30	.18	0.02				.68
27 to 27.9.....................		.19	.93	1.02	.41	0.01			2.56
28 to 28.9.....................		.08	1.27	3.30	2.16	.11			6.92
29 to 29.9.....................		.03	.45	4.29	4.49	1.34	0.01		10.61
30 to 30.9.....................			.09	2.68	4.35	2.39	.08		9.59
31 to 31.9.....................			.04	.95	2.59	1.77	.17		5.52
32 to 32.9.....................				.13	.91	.79	.23		2.06
33 to 33.9.....................				.02	.19	.26	.11	0.01	.59
34 to 34.9.....................					.03	.08	.04		.15
35 to 35.9.....................						.01			.01
Total	.03	.52	3.11	12.58	15.15	6.76	.64	.01	38.80

1/ Area between dotted lines is the range of backfat thickness for each carcass length according to the weight and measurement guides in the official standards for U. S. No.2.

Table 5.--U. S. No. 3 barrows and gilts: Distribution of carcasses by length and average backfat thickness, as percentages of all barrows and gilts in survey, 56 packing plants, September 1960 to August 1961

Carcass length	Average backfat thickness (inches)									
	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	Over 2.5	Total
Inches	Pct. 1/:	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
25 to 25.9................:	0.01	0.02	0.01	0.01	0.01					0.06
26 to 26.9................:	.03	.10	.06	.05	.02	0.01	0.01	0.01	0.01	.30
27 to 27.9................:	.04	.46	.50	.26	.17	.09	.04	.02	.03	1.61
28 to 28.9................:	.02	.80	1.83	.81	.50	.28	.12	.08	.06	4.50
29 to 29.9................:		.32	2.46	1.44	.97	.58	.25	.14	.13	6.29
30 to 30.9................:		.12	1.80	1.77	1.10	.65	.35	.19	.26	6.24
31 to 31.9................:		.01	.70	1.15	.99	.52	.29	.19	.26	4.11
32 to 32.9................:			.14	.47	.47	.26	.22	.13	.16	1.85
33 to 33.9................:		.01	.03	.12	.15	.09	.12	.07	.10	.69
34 to 34.9................:			.01	.02	.04	.04	.03	.03	.04	.21
35 to 35.9................:				.01	.01	.01	.01		.01	.05
36 to 36.9................:					.01		.01	.01	.01	.04
Total ....:	.10	1.84	7.54	6.11	4.44	2.53	1.45	.87	1.07	25.95

1/ Dotted line shows minimum backfat thickness for each carcass length according to the weight and measurement guides in the official standards for U. S. No. 3.

Table 6.--Medium and Cull barrows and gilts: Distribution of carcasses by length and average backfat thickness, as percentages of all barrows and gilts graded in survey, 56 packing plants, September 1960 to August 1961

Carcass length	Average backfat thickness (inches)									Cull--
	Medium									
	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	Total	0.8 and under
Inches	Pct.	Pct. 1/	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.:	Pct.
25 to 25.9................:	0.01	0.01		0.02					0.04:	0.01
26 to 26.9................:		.01	0.04	.02	0.03				.10:	.02
27 to 27.9................:		.01	.11	.07	.06				.25:	.02
28 to 28.9................:		.01	.10	.19	.10	0.03			.43:	.02
29 to 29.9................:		.01	.12	.21	.16	.04			.54:	.03
30 to 30.9................:		.01	.09	.11	.14	.03			.38:	.01
31 to 31.9................:			.04	.06	.08	.02			.20:	.02
32 to 32.9................:			.02	.03	.03	.02			.10:	.01
33 to 33.9................:				.01	.02				.03:	
Total ....:	.01	.06	.52	.72	.62	.14	0	0	2.07	.14

1/ Area between dotted lines shows range of backfat thickness for each carcass length according to the weight and measurement guides in the official standards for Medium. Cull grade boundaries are not indicated.

Other Studies

A number of local estimates of hog grade composition and at least one national estimate have been made.

Animal husbandmen from the North Dakota State University graded 72,000 live hogs at the West Fargo yards over a 2=year period, 1955-56 (table 7) (2).

In a training session for USDA livestock market news reporters, over 6,000 live hogs were graded in the fall of 1957 at a terminal market in region 7 (table 7).

Table 7--Results of other barrow and gilt grade distribution studies-- percentage distribution by grade

Study	U. S. No. 1	U. S. No. 2	U. S. No. 3	Medium and Cull
North Dakota:				
1955	40	32	22	6
1956	32	43	24	1
USDA Market News (fall 1957) ....:	22	52	26	--
American Meat Institute survey (1956-57)1/:	29	42	27	2
University of Illinois:				
June 1957 ....:	15	37	46	2
June 1958 ....:	18	39	40	3
Purdue University:				
Jan. and Feb. 1959 ....:	24	35	41	--
Oct. 1960 ....:	15	42	41	2
Jan. 1960 ....:	31	40	20	9
Jan. 1961 ....:	33	40	19	8
June 1961 ....:	21	38	37	4

1/ Conducted September 1956 and April 1957. Results were similar in both periods.

The American Meat Institute Provisions Committee conducted a sample survey in 1956-57 in which packers, estimating where necessary, gave the grade distributuion for their slaughter barrows and gilts.

In June 1957, nearly 22,000 hog carcasses were graded by University of Illinois livestock and meat specialists at a terminal market (3). In June 1958, the University of Illinois graded another 24,000 carcasses. In both Illinois surveys, the grades were based strictly on measurements and no subjective evaluations were used. 4/

Purdue livestock and meat specialists graded but did not measure over 23,000 pork carcasses at four major plants in central Indiana in January and February 1959 (4). On four occasions, beginning in January 1960, Purdue specialists measured and assigned grades based solely on the measurement guides to around 6,000 carcasses. 5/

4/ Personal communication from M. B. Kirtley, Illinois Agricultural Extension Service. Feb. 23, 1960.

5/ Personal communication from Norton Smith, Purdue University Agricultural Experiment Station. Sept. 1, 1961.

These studies were conducted at different times and places and the differences in their results are no indication of differences in their accuracy or representativeness. Although the present study is probably more accurate in estimating the U. S. average 1960-61 consist, the estimates in table 3 are no doubt representative of their time and area.

In the North Dakota study, the Purdue study, and this study, samples were taken more or less regularly over a period of several months. All showed substantial differences in percentages of U. S. No. 1 and No. 3 at different times of the year. This indicates a need to sample throughout a complete year to insure an accurate estimate of grade consist for any area.

Comparison with Canada

Canada produces a much higher proportion of hogs that would grade U. S. No. 1 than the United States produces. An analysis of data gathered in October 1957, using our grade standards, indicated that Canada produced about twice the proportion of hogs of a quality that would grade U. S. No. 1 (71 percent for Canada in 1957, compared with 33 percent for the U. S. in 1960-61). Canada produced 26 percent U. S. No. 2 as compared with about 39 percent in this country. Canada has almost eliminated hogs that would grade U. S. No. 3; in 1957, only 2 percent of hogs marketed in Canada were this type (1, p. 24). In the United States, however, 26 percent were No. 3 in 1960-61.

GRADES OF SOWS

About 6,000 sow carcasses were graded during the year's work. The grader was instructed to grade any carcass that appeared before him as selected by the line sampling rate in use at that plant. The only exceptions were stag and boar carcasses and a very few carcasses that were not split. Carcass grade standards do not exist for these exceptions. Stags and boars account for about one-half of 1 percent of federally inspected hog slaughter.

The distribution of the sow carcasses by grade was:

	Percent
U. S. No. 1	33
U. S. No. 2	35
U. S. No. 3	24
Medium	7
Cull	1

Regional differences were not analyzed. For sow carcasses, differences in the results between trips were small. About the same proportions were found in each trip as in the national average given above.

Some plants kill very few sows and others have a large trade in sows. The sample of plants was not drawn to give all sows equal probability of being graded. Since the sample was drawn to represent all hogs it was composed mainly of barrows and gilts. The statistical confidence limits on the accuracy of the sow grade consist are not known.

Carcass length seems to have little influence on the proportion of valuable lean cuts in sow carcasses. Therefore, the distribution of sow carcasses by length was not tabulated. The percentage distribution of sows by backfat and grade is given in table 8.

Table 8.--All sows graded in survey, percentage distribution by backfat thickness and carcass grade, 56 packing plants, September 1960 to August 1961 1/

Average backfat thickness and grade indicated in U.S. standards (Inches)	Actual carcass grade assigned					
	Cull Percent	Medium Percent	U.S. No. 1 Percent	U.S. No. 2 Percent	U.S. No. 3 Percent	Total Percent
0.8 and down (Cull)	0.56	0.04				0.60
0.9 (Cull)	.28					.28
1.0 (Cull)	.34	.39				.73
1.1 (Cull, Medium) .	.08	1.00				1.08
1.2 (Medium)		2.50				2.50
1.3 (Medium)		2.24	0.31			2.55
1.4 (Medium)		.36	3.04			3.40
1.5 (Medium, No. 1) .		.05	5.49			5.54
1.6 (U. S. No. 1) . .			5.86			5.86
1.7 (U. S. No. 1) . .			8.16	0.18		8.34
1.8 (U. S. No. 1) . .			8.18	1.01		9.19
1.9 (U. S. No. 1, No. 2) . . .			1.96	3.28		5.24
2.0 (U. S. No. 2) . .			.07	10.64		10.71
2.1 (U. S. No. 2) . .				10.55	0.08	10.63
2.2 (U. S. No. 2) . .				7.58	.22	7.80
2.3 (U. S. No. 2, No. 3) . . .				1.71	2.14	3.85
2.4 (U. S. No. 3) . .				.25	4.99	5.24
2.5 (U. S. No. 3) . .				.02	4.54	4.56
2.6 (U. S. No. 3) . .					3.90	3.90
2.7 (U. S. No. 3) . .					2.44	2.44
2.8 (U. S. No. 3) . .					1.77	1.77
2.9 (U. S. No. 3) . .					1.14	1.14
3.0 and over (U. S. No. 3) . .					2.65	2.65
Total	1.26	6.58	33.07	35.22	23.87	100.00

1/ Because the importance of sow slaughter varies from plant to plant, the proportions in each grade at each plant were weighted by the relative importance of sow slaughter at that plant on the day of the grader's visit.

APPENDIX

The Sample

From the 145 federally inspected plants that slaughtered more than 100,000 hogs in 1959, the 56 plants in the sample were drawn with a probability proportional to their 1959 hog slaughter volume. Therefore, each hog in the population had about the same chance of being graded if the grader could manage to grade the same number of carcasses at each plant. He accomplished this fairly well by staying at a plant a full day and grading about a carcass per minute while working. Furthermore, by staying a full day, he eliminated time of day as a source of variation in the results.

Since some plants kill different types of hogs separately, a full day's kill was needed to represent a plant's consist. If the grader was unable to get to the killing line at the beginning of the day's kill, or if he had to leave before the end, he indicated the number and type of hogs that he was unable to grade. The data on hogs graded at that plant were adjusted accordingly, and each plant visit was given equal weight.

Except for region 9 (see fig. 1), the grader visited about one-half the sample plants in all the regions during each of the four trips. Region 9 contained fewer hogs (and thus fewer sample plants) than the others, and also presented heavy travel costs because of the distance between plants. Therefore, the grader entered region 9 only twice, visiting all four selected plants each time. Thus, region 9 was sampled at the same rate, but since all the sampling was done during two of the four trips data on grade differences at different times during the sample year were not so complete.

Selection of Plants

Slightly less than one plant was selected for each million head slaughtered by federally inspected plants in 1959.

For the sample draw, the list of qualified plants in a region was arranged in a logical travel order with the 1959 hog slaughter (head) listed after each plant. Then, the individual volumes were cumulated as in the short hypothetical example below:

Plant	Volume	Cumulative total volume
A	205,540	205,540
B	352,556	558,096
C	1,396,397	1,954,493
D	432,757	2,387,250

A region of this size would have had two plants drawn (between 2 and 3 million head total slaughter in the population of plants). Therefore, the 2,387,250 would be divided by 2, giving 1,193,625. A random number between 1 and 1,193,625 would be selected. If it had been 723,455, for example, that figure in the cumulative total column would represent the 723,455th hog slaughtered in the region. This hog was slaughtered in plant C, so plant C will be visited by the grader. Then by systematic steps the next plants would be selected by adding 1,193,625 once for each additional plant needed. In the hypothetical region, there is only room for adding the number

one more time. In this case 723,455 plus 1,193,625=1,917,080. The 1,917,080th hog was also killed in plant C, so in this sample region both stops are at plant C.

Under this sampling plan hogs, not plants, were sampled. Each hog had practically an equal chance of being selected. Because small plants killed fewer hogs they had a smaller chance of being drawn in the sample.

Because the grader visited plants in each region (except region 9) each trip, the data provided a national sample for each 2-month trip.

The 95 percent confidence limits for each grade percentage were all less than two percentage points on either side of the estimate (see footnote 2, page 5). This indicates that the sample was large enough for national estimates. [1] Estimates were not as precise for regions within the country. For regions 1 and 2 (fig. 1), the 95 percent confidence limits for grades 1 and 3 were each over five percentage points on either side of the estimate. For other grades and other regions, the limits were mostly under three percentage points.

Table 9 shows, for the regions of figure 1, the total number of federally inspected plants, their hog slaughter volume in 1959, and the number and total volumes of plants killing more than 100,000 hogs each. Also listed is the number of plants drawn in the sample and the number of barrows and gilts actually graded in each region.

The 1959 data on federally inspected slaughter were used as the basis for determining the number of plants to visit in the 1960-61 survey. Federally inspected plants slaughtering less than 100,000 hogs per year were not in the sample as such plants would not have provided enough hogs to keep the grader busy.

About 15 percent of total commercial hog slaughter took place in plants that were not federally inspected. These plants were excluded from the population sampled in this study because most were too small to keep the grader busy for a day, and because of the difficulty of obtaining a listing of the plants with their hog slaughter volume from which a sample could be drawn.

An adequate sample of nonfederally inspected and small federally inspected plants would have added materially to the costs of planning and of conducting this study.

If the grade consist of the noninspected plants were known to be the same as that for inspected plants, then the present sample could be said to describe nearly all hog slaughter. However, there appears to be some difference in the types of hogs slaughtered in the two classes of plants. From 1956 through 1960, hogs killed in federally inspected plants weighed 16 to 17 pounds (live weight) more than those killed in other commercial slaughtering plants. In the early 1950's this figure varied from 21 to 28 pounds. The extent to which federally inspected plants slaughter heavier, fatter barrows and gilts or a higher proportion of sows is not known.

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[1] The average percentage of barrows and gilts in a grade for the two visits to a plant was used as the unit of observation in computing the sampling error. Twice the standard error of the mean of the 61 observations for each grade was assumed to approximate the distance from an estimate to its 95% confidence limits.

Table 9.--Survey of U. S. commercial hog slaughter: Plants from which sample was drawn, number of plants in sample, and number of barrows and gilts graded September 1960 to August 1961

Region	Total commercial hog slaughter, 1959	Federally inspected plants slaughtering hogs, 1959				Sample			
	Mil. head	Total		Slaughtering over 100,000 hogs		Trip 1 and 3	Trip 2 and 4	Total	Barrows and gilts graded
		Plants	Slaughter, Mil. head	Plants	Slaughter, Mil. head	Plants	Plants	Plants	Carcasses
1	7.6	33	5.8	17	5.4	2	3	5	3,379
2	11.4	45	6.9	27	6.3	3	3	6	3,747
3	10.9	27	7.5	20	7.1	4	3	1/7	5,011
4	9.3	23	8.5	15	8.2	4	4	1/8	6,726
5	4/15.2	5	8.3	5	8.3	1/4	2/4	3/8	6,649
6		12	6.8	10	6.8	3	3	6	4,402
7	8.1	15	8.0	12	7.9	4	1/3	7	5,081
8	11.7	23	11.2	17	11.1	5	5	10	7,848
9	7.5	80	5.5	22	4.7	0	5/4,3	4	2,070
Total	81.7	263	68.5	145	65.8	29	32,31	61	44,913

1/ Includes one plant drawn twice, each draw counted. In region 3, the plant drawn twice was visited once every trip. In other regions, such plants were visited on two consecutive days every other trip.

2/ Two stops were drawn at both plants but on the 4th trip one plant was closed. One day was spent in each of two nearby plants.

3/ Includes three plants drawn twice.

4/ Separate totals for regions 5 and 6 were not available.

5/ One plant was closed in fourth trip. It was not replaced in the sample.

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